In the Specification

Kindly replace paragraph [0001] with the following:

[Technical ~~field~~]Field

Kindly replace paragraph [0003] with the following:

[Background ~~art~~]

Cosmetics with diverse functions are proposed recently. For example, they include cosmetics capable of easily keeping the skin healthy, capable of favorably adhering to the skin and capable of being easily washed away, cosmetics containing ingredients capable of preventing aging and keratinization such as collagen, hyaluronic acid, squalane and urea or an ingredient capable of preventing skin roughening such as allantoin, skin whitening cosmetics containing an ultraviolet absorber such as benzophenone or zinc oxide for preventing blackening, ephelides or freckles, or containing a melanin production inhibitor such as arbutin or squalane, or capable of activating skin cells, cosmetics containing a moisture retaining agent or moistening agent such as glycerol, hyaluronic acid, silicone or lanolin and capable of keeping the skin moist, fresh and youthful, cosmetics containing an organic substance and capable of keeping the intended cosmetic effect lasting longer, cosmetics capable of preventing the darkening or partial glistening of the skin, cosmetics capable of expressing quality such as transparency or color tone, etc.

Kindly replace paragraphs [0025] through [0035] with the following:

~~[Disclosure of the invention]~~Summary

~~[Problems to be solved by the invention]~~

~~The object of this invention is to~~We provide compound solutions, emulsions and gels excellent in homogeneous dispersibility and in the long-term stability of dispersion and also excellent in the properties as cosmetics.

Furthermore, ~~this invention~~we provide[[s]] synthetic papers composed of nanofibers not limited in the form or polymer used, allowing a wide range of application and small in the irregularity of single fiber diameter~~. This invention also provides~~, and a production method thereof.

~~[Means for solving the problems]~~

~~To solve the aforesaid problems, this invention has the following constitutions.~~Thus, we provide the following:

(1) A compound solution comprising disarranged fibers made of a thermoplastic polymer, and of 1 to 500 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios, and a solvent.

(2) A compound solution comprising disarranged fibers made of a thermoplastic polymer, and of 1 to 200 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios, and a solvent.

(3) A compound solution, according to said (1) or (2), wherein the index Pb of extremal coefficient of single fiber diameters expressing the rate of the fibers falling within a range of plus and minus 15 nm from the number average single fiber diameter defined as the median is 50% or more.

(4) A compound solution, according to ~~any one of~~ said (1) ~~through (3)~~, wherein the solvent is at least one selected from the group consisting of water, oils and organic solvents.

(5) A compound solution, according to ~~any one of~~ said (1) ~~through (4)~~or (2), wherein the freeness of the disarranged fibers is 350 or less.

(6) A compound solution, according to ~~any one of~~ said (1) ~~through (5)~~, wherein the content of the disarranged fibers is 5 wt% or less.

~~(7) A compound solution, according to said (6), wherein the content of the disarranged fibers is 0.0001 to 1 wt%.~~

~~(8) A compound solution, according to any one of said (1) through (7), wherein the disarranged fibers are short fibers with a fiber length of 5 mm or less.~~

~~(9) A compound solution, according to any one of said (1) through (7), wherein the disarranged fibers are short fibers with a fiber length of 0.05 to 2 mm.~~

~~(10) A compound solution, according to any one of said (1) through (9), wherein the thermoplastic polymer is at least one selected from the group consisting of polyesters, polyamides, polyolefins, polyphenylene sulfide, phenol resins, polyacrylonitrile, polyvinyl alcohol, polysulfones, polyurethanes, fluorine-based polymers and their derivatives.~~

~~(11) A compound solution, according to any one of said (1) through (10), which further contains a dispersing agent.~~

~~(12) A compound solution, according to said (11), wherein the content of the dispersing agent is 0.00001 to 20 wt%.~~

~~(13) A compound solution, according to said (11), wherein the content of the dispersing agent is 0.0001 to 5 wt%.~~

~~(14) A compound solution, according to any one of said (11) through (13), wherein the dispersing agent is at least one selected from the group consisting of nonionic dispersing agents, anionic dispersing agents and cationic dispersing agents.~~

~~(15) A compound solution, according to said (14), wherein the zeta potential of the disarranged fibers is in a range from -5 to +5 mV, and the dispersing agent is a nonionic dispersing agent.~~

~~(16) A compound solution, according to said (14), wherein the zeta potential of the disarranged fibers is -100 mV to less than -5 mV, and the dispersing agent is an anionic dispersing agent.~~

~~(17) A compound solution, according to said (14), wherein the zeta potential of the disarranged fibers is more than +5 mV to 100 mV, and the dispersing agent is a cationic dispersing agent.~~

~~(18) A compound solution, according to any one of said (11) through (17), wherein the molecular weight of the dispersing agent is 1000 to 50000.~~

~~(19) An emulsion comprising disarranged fibers made of a thermoplastic polymer, and of 1 to 500 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios, and a solvent.~~

~~(20) An emulsion comprising disarranged fibers made of a thermoplastic polymer, and of 1 to 200 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios, and a solvent.~~

~~(21) An emulsion, according to said (19) or (20), wherein the index Pb of extremal coefficient of the single fiber diameters expressing the rate of the fibers falling within a range of plus and minus 15 nm from the number average single fiber diameter defined as the median is 50% or more.~~

~~(22) An emulsion, according to any one of said (19) through (21), wherein the solvent is at least one selected from the group consisting of water, oils and organic solvents.~~

~~(23) An emulsion, according to any one of said (19) through (22), wherein the freeness of the disarranged fibers is 350 or less.~~

~~(24) An emulsion, according to any one of said (19) through (23), wherein the content of the disarranged fibers is 5 wt% or less.~~

~~(25) An emulsion, according to any one of said (19) through (23), wherein the content of the disarranged fibers is 0.0001 to 1 wt%.~~

~~(26) An emulsion, according to said (19) through (25), wherein the disarranged fibers are short fibers with a fiber length of 5 mm or less.~~

~~(27) An emulsion, according to said (26), wherein the disarranged fibers are short fibers with a fiber length of 0.05 to 0.8 mm.~~

~~(28) An emulsion, according to any one of said (19) through (27), wherein the thermoplastic polymer is at least one selected from the group consisting of polyesters, polyamides, polyolefins, polyphenylene sulfide, phenol resins, polyacrylonitrile, polyvinyl alcohol, polysulfones, polyurethanes, fluorine-based polymers and their derivatives.~~

~~(29) An emulsion, according to any one of said (19) through (28), which further contains a dispersing agent.~~

~~(30) An emulsion, according to said (29), wherein the content of the dispersing agent is 0.00001 to 20 wt%.~~

~~(31) An emulsion, according to said (29), wherein the content of the dispersing agent is 0.0001 to 5 wt%.~~

~~(32) An emulsion, according to any one of said (29) through (31), wherein the dispersing agent is at least one selected from the group consisting of nonionic dispersing agents, anionic dispersing agents and cationic dispersing agents.~~

~~(33) An emulsion, according to said (32), wherein the zeta potential of the disarranged fibers is in a range from -5 to +5 mV, and the dispersing agent is a nonionic dispersing agent.~~

~~(34) An emulsion, according to said (32), wherein the zeta potential of the disarranged fibers is -100 mV to less than -5 mV, and the dispersing agent is an anionic dispersing agent.~~

~~(35) An emulsion, according to said (32), wherein the zeta potential of the disarranged fibers is more than +5 mV to 100 mV, and the dispersing agent is a cationic dispersing agent.~~

~~(36) An emulsion, according to any one of said (29) through (35), wherein the molecular weight of the dispersing agent is 1000 to 50000.~~

~~(37) A gel comprising disarranged fibers made of a thermoplastic polymer, and of 1 to 500 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios, and a solvent.~~

~~(38) A gel comprising disarranged fibers made of a thermoplastic polymer, and of 1 to 200 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios, and a solvent.~~

~~(39) A gel, according to said (37) or (38), wherein the index Pb of extremal coefficient of the single fiber diameters expressing the rate of the fibers falling within a range of plus and minus 15 nm from the number average single fiber diameter defined as the median is 50% or more.~~

~~(40) A gel, according to any one of said (37) through (39), wherein the solvent is at least one selected from the group consisting of water, oils and organic solvents.~~

~~(41) A gel, according to any one of said (37) through (40), wherein the freeness of the disarranged fibers is 350 or less.~~

~~(42) A gel, according to any one of said (37) through (41), wherein the content of the disarranged fibers is 30 wt% or less.~~

~~(43) A gel, according to said (42), wherein the content of the disarranged fibers is 1 to 5 wt%.~~

~~(44) A gel, according to said (37) through (43), wherein the disarranged fibers are short fibers with a fiber length of 5 mm or less.~~

~~(45) A gel, according to any one of said (44), wherein the disarranged fibers are short fibers with a fiber length of 0.2 to 1 mm.~~

~~(46) A gel, according to any one of said (37) through (45), wherein the thermoplastic polymer is at least one selected from the group consisting of polyesters, polyamides, polyolefins, polyphenylene sulfide, phenol resins, polyacrylonitrile, polyvinyl alcohol, polysulfones, polyurethanes, fluorine-based polymers and their derivatives.~~

~~(47) A gel, according to any one of said (37) through (46), which further contains a dispersing agent.~~

~~(48) A gel, according to said (47), wherein the content of the dispersing agent is 0.00001 to 20 wt%.~~

~~(49) A gel, according to said (47), wherein the content of the dispersing agent is 0.0001 to 5 wt%.~~

~~(50) A gel, according to any one of said (47) through (49), wherein the dispersing agent is at least one selected from the group consisting of nonionic dispersing agents, anionic dispersing agents and cationic dispersing agents.~~

~~(51) A gel, according to said (50), wherein the zeta potential of the disarranged fibers is in a range from -5 to +5 mV, and the dispersing agent is a nonionic dispersing agent.~~

~~(52) A gel, according to said (50), wherein the zeta potential of the disarranged fibers is -100 mV to less than -5 mV, and the dispersing agent is an anionic dispersing agent.~~

~~(53) A gel, according to said (50), wherein the zeta potential of the disarranged fibers is more than +5 mV to 100 mV, and the dispersing agent is a cationic dispersing agent.~~

~~(54) A gel, according to any one of said (47) through (53), wherein the molecular weight of the dispersing agent is 1000 to 50000.~~

~~(55) A cosmetic comprising the compound solution, emulsion or gel as set forth in any one of said (1) through (54).~~

~~(56) A paint comprising the compound solution, emulsion or gel as set forth in any one of said (1) through (54).~~

~~(57) A method for producing the compound solution, emulsion or gel as set forth in any one of said (1) through (54), comprising the step of directly beating a fiber aggregate in at least one selected from the group consisting of water, oils and organic solvents.~~

~~(58) A nanofiber synthetic paper comprising disarranged nanofibers of a thermoplastic polymer of 1 to 500 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios.~~

~~(59) A nanofiber synthetic paper, according to said (58), which comprises disarranged nanofibers of a thermoplastic polymer of 1 to 200 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios.~~

~~(60) A nanofiber synthetic paper, according to said (58) or (59), wherein the index Pb of extremal coefficient of the single fiber diameters expressing the rate of the fibers falling within a range of plus and minus 15 nm from the number average single fiber diameter defined as the median is 50% or more.~~

~~(61) A nanofiber synthetic paper, according to any one of said (58) through (60), wherein the freeness of the disarranged nanofibers is 350 or less.~~

~~(62) A nanofiber synthetic paper, according to any one of said (58) through (61), which has a weight per unit area of 50 g/m^2 or less.~~

~~(63) A nanofiber synthetic paper, according to any one of said (58) through (62), which has a thickness of 10 μm or more.~~

~~(64) A nanofiber synthetic paper, according to any one of said (58) through (63), which has a density of 0.3 g/cm^3 or less.~~

~~(65) A nanofiber synthetic paper, according to any one of said (58) through (64), which has a number average pore area of 1 μm^2 or less.~~

~~(66) A nanofiber synthetic paper, according to any one of said (58) through (65), which has an air permeability of 30 cc/cm^2/sec or less.~~

~~(67) A nanofiber synthetic paper, according to any one of said (58) through (66), wherein the number of holes with a diameter of 50 μm or more passing through from the front side to the reverse side of the synthetic paper is 0 to 1000 holes/cm^2.~~

~~(68) A nanofiber synthetic paper, according to any one of said (58) through (67), which has a surface smoothness of 300 seconds or more.~~

~~(69) A nanofiber synthetic paper, according to any one of said (58) through (68), wherein the thermoplastic polymer constituting the disarranged nanofibers has a melting point of 165°C or higher.~~

~~(70) A nanofiber synthetic paper, according to any one of said (58) through (69), wherein the thermoplastic polymer constituting the disarranged nanofibers is at least one selected from the group consisting of polyesters, polyamides, polyolefins, polyphenylene sulfide, phenol resins, polyacrylonitrile, polyvinyl alcohol, polysulfones, polyurethanes, fluorine-based polymers and their derivatives.~~

~~(71) A nanofiber synthetic paper, according to any one of said (58) through (70), which further contains at least 5 wt% or more of other fibers with a number average single fiber diameter of 1 μm or more.~~

~~(72) A nanofiber synthetic paper, according to any one of said (58) through (70), which further contains other fibers with a number average single fiber diameter of 1 μm or more, and 3 wt% or less of the disarranged nanofibers.~~

~~(73) A nanofiber synthetic paper, according to any one of said (58) through (70), wherein the disarranged nanofibers are laminated on a substrate.~~

~~(74) A nanofiber synthetic paper, according to said (73), wherein the substrate is selected from a woven fabric, knitted fabric, nonwoven fabric and foam.~~

~~(75) A compound synthetic paper comprising the nanofiber synthetic paper as set forth in any one of said (58) through (74).~~

~~(76) A molded synthetic paper comprising the nanofiber synthetic paper as set forth in any one of said (58) through (74).~~

~~(77) A filter comprising the nanofiber synthetic paper as set forth in any one of said (58) through (74).~~

~~(78) A separator comprising the nanofiber synthetic paper as set forth in any one of said (58) through (74).~~

~~(79) An abrasive comprising the nanofiber synthetic paper as set forth in any one of said (58) through (74).~~

~~(80) A medical product comprising the nanofiber synthetic paper as set forth in any one of said (58) through (74).~~

~~(81) A circuit board comprising the nanofiber synthetic paper as set forth in any one of said (58) through (74).~~

~~(82) A method for producing a nanofiber synthetic paper by forming a paper sheet from a dispersion of beaten short nanofibers, characterized in that the paper sheet is formed without using a binder.~~

~~(83) A method for producing a nanofiber synthetic paper, characterized in that other fibers with a number average single fiber diameter of 1 μm or more are processed to form a paper sheet using disarranged nanofibers as a binder.~~

(84) A compound solution, according to said (1), wherein the disarranged fibers are short fibers with a fiber length of 5 mm or less.

(85) A compound solution, according to said (1), wherein the thermoplastic polymer is at least one selected from the group consisting of polyesters, polyamides, polyolefins, polyphenylene sulfide, phenol resins, polyacrylonitrile, polyvinyl alcohol, polysulfones, polyurethanes, fluorine-based polymers and their derivatives.

(86) A compound solution, according to said (1), which further contains a dispersing agent.

(87) A compound solution, according to said (86), wherein the content of the dispersing agent is 0.00001 to 20 wt%.

(88) A compound solution, according to said (86), wherein the dispersing agent is at least one selected from the group consisting of nonionic dispersing agents, anionic dispersing agents and cationic dispersing agents.

(89) A compound solution, according to said (88), wherein the zeta potential of the disarranged fibers is in a range from -5 to +5 mV, and the dispersing agent is a nonionic dispersing agent.

(90) A compound solution, according to said (88), wherein the zeta potential of the disarranged fibers is -100 mV to less than -5 mV, and the dispersing agent is an anionic dispersing agent.

(91) A compound solution, according to said (88), wherein the zeta potential of the disarranged fibers is more than +5 mV to 100 mV, and the dispersing agent is a cationic dispersing agent.

(92) A compound solution, according to said (86), wherein the molecular weight of the dispersing agent is 1000 to 50000.

(93) An emulsion comprising disarranged fibers made of a thermoplastic polymer, and of 1 to 500 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios, and a solvent.

(94) An emulsion comprising disarranged fibers made of a thermoplastic polymer, and of 1 to 200 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios, and a solvent.

(95) An emulsion, according to said (93) or (94), wherein the index Pb of extremal coefficient of the single fiber diameters expressing the rate of the fibers falling within a range of plus and minus 15 nm from the number average single fiber diameter defined as the median is 50% or more.

(96) An emulsion, according to said (93), wherein the solvent is at least one selected from the group consisting of water, oils and organic solvents.

(97) An emulsion, according to said (93) or (94), wherein the freeness of the disarranged fibers is 350 or less.

(98) An emulsion, according to said (93), wherein the content of the disarranged fibers is 5 wt% or less.

(99) An emulsion, according to said (93), wherein the disarranged fibers are short fibers with a fiber length of 5 mm or less.

(100) An emulsion, according to said (93), wherein the thermoplastic polymer is at least one selected from the group consisting of polyesters, polyamides, polyolefins, polyphenylene sulfide, phenol resins, polyacrylonitrile, polyvinyl alcohol, polysulfones, polyurethanes, fluorine-based polymers and their derivatives.

(101) An emulsion, according to said (93), which further contains a dispersing agent.

(102) An emulsion, according to said (101), wherein the content of the dispersing agent is 0.00001 to 20 wt%.

(103) An emulsion, according to said (101), wherein the dispersing agent is at least one selected from the group consisting of nonionic dispersing agents, anionic dispersing agents and cationic dispersing agents.

(104) An emulsion, according to said (103), wherein the zeta potential of the disarranged fibers is in a range from -5 to +5 mV, and the dispersing agent is a nonionic dispersing agent.

(105) An emulsion, according to said (103), wherein the zeta potential of the disarranged fibers is -100 mV to less than -5 mV, and the dispersing agent is an anionic dispersing agent.

(106) An emulsion, according to said (103), wherein the zeta potential of the disarranged fibers is more than +5 mV to 100 mV, and the dispersing agent is a cationic dispersing agent.

(107) An emulsion, according to said (101), wherein the molecular weight of the dispersing agent is 1000 to 50000.

(108) A gel comprising disarranged fibers made of a thermoplastic polymer, and of 1 to 500 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios, and a solvent.

(109) A gel comprising disarranged fibers made of a thermoplastic polymer, and of 1 to 200 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios, and a solvent.

(110) A gel, according to said (108) or (109), wherein the index Pb of extremal coefficient of the single fiber diameters expressing the rate of the fibers falling within a range of plus and minus 15 nm from the number average single fiber diameter defined as the median is 50% or more.

(111) A gel, according to said (108), wherein the solvent is at least one selected from the group consisting of water, oils and organic solvents.

(112) A gel, according to said (108) or (109), wherein the freeness of the disarranged fibers is 350 or less.

(113) A gel, according to said (108), wherein the content of the disarranged fibers is 30 wt% or less.

(114) A gel, according to said (108), wherein the disarranged fibers are short fibers with a fiber length of 5 mm or less.

(115) A gel, according to said (108), wherein the thermoplastic polymer is at least one selected from the group consisting of polyesters, polyamides, polyolefins, polyphenylene

sulfide, phenol resins, polyacrylonitrile, polyvinyl alcohol, polysulfones, polyurethanes, fluorine-based polymers and their derivatives.

(116) A gel, according to said (108), which further contains a dispersing agent.

(117) A gel, according to said (116), wherein the content of the dispersing agent is 0.00001 to 20 wt%.

(118) A gel, according to said (116), wherein the dispersing agent is at least one selected from the group consisting of nonionic dispersing agents, anionic dispersing agents and cationic dispersing agents.

(119) A gel, according to said (118), wherein the zeta potential of the disarranged fibers is in a range from -5 to +5 mV, and the dispersing agent is a nonionic dispersing agent.

(120) A gel, according to said (118), wherein the zeta potential of the disarranged fibers is -100 mV to less than -5 mV, and the dispersing agent is an anionic dispersing agent.

(121) A gel, according to said (118), wherein the zeta potential of the disarranged fibers is more than +5 mV to 100 mV, and the dispersing agent is a cationic dispersing agent.

(122) A gel, according to said (116), wherein the molecular weight of the dispersing agent is 1000 to 50000.

(123) A cosmetic comprising the compound solution, emulsion or gel as set forth in said (1).

(124) A cosmetic comprising the emulsion as set forth in said (93).

(125) A cosmetic comprising the gel as set forth in said (108).

(126) A paint comprising the compound solution as set forth in said (1).

(127) A paint comprising the emulsion as set forth in said (93).

(128) A paint comprising the gel as set forth in said (108).

(129) A method for producing the compound solution as set forth in said (1), comprising the step of directly beating a fiber aggregate in at least one selected from the group consisting of water, oils and organic solvents.

(130) A method for producing the emulsion as set forth in said (93), comprising the step of directly beating a fiber aggregate in at least one selected from the group consisting of water, oils and organic solvents.

(131) A method for producing the gel as set forth in said (108), comprising the step of directly beating a fiber aggregate in at least one selected from the group consisting of water, oils and organic solvents.

(132) A nanofiber synthetic paper comprising disarranged nanofibers of a thermoplastic polymer of 1 to 500 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios.

(133) A nanofiber synthetic paper, according to said (58), which comprises disarranged nanofibers of a thermoplastic polymer of 1 to 200 nm in the number average single fiber diameter and 60% or more in the sum Pa of single fiber ratios.

(134) A nanofiber synthetic paper, according to said (132) or (133), wherein the index Pb of extremal coefficient of the single fiber diameters expressing the rate of the fibers falling within a range of plus and minus 15 nm from the number average single fiber diameter defined as the median is 50% or more.

(135) A nanofiber synthetic paper, according to said (132) or (133), wherein the freeness of the disarranged nanofibers is 350 or less.

(136) A nanofiber synthetic paper, according to said (132), which has a weight per unit area of 50 g/m^2 or less.

(137) A nanofiber synthetic paper, according to said (132), which has a thickness of 10 μm or more.

(138) A nanofiber synthetic paper, according to said (132), which has a density of 0.3 g/cm^3 or less.

(139) A nanofiber synthetic paper, according to said (132), which has a number average pore area of 1 μm^2 or less.

(140) A nanofiber synthetic paper, according to said (132) or (133), which has an air permeability of 30 $cc/cm^2/sec$ or less.

(141) A nanofiber synthetic paper, according to said (132), wherein the number of holes with a diameter of 50 μm or more passing through from the front side to the reverse side of the synthetic paper is 0 to 1000 $holes/cm^2$.

(142) A nanofiber synthetic paper, according to said (132) or (133), which has a surface smoothness of 300 seconds or more.

(143) A nanofiber synthetic paper, according to said (132), wherein the thermoplastic polymer constituting the disarranged nanofibers has a melting point of 165°C or higher.

(144) A nanofiber synthetic paper, according to said (132), wherein the thermoplastic polymer constituting the disarranged nanofibers is at least one selected from the group consisting of polyesters, polyamides, polyolefins, polyphenylene sulfide, phenol resins, polyacrylonitrile, polyvinyl alcohol, polysulfones, polyurethanes, fluorine-based polymers and their derivatives.

(145) A nanofiber synthetic paper, according to said (132), which further contains at least 5 wt% or more of other fibers with a number average single fiber diameter of 1 μm or more.

(146) A nanofiber synthetic paper, according to said (132), which further contains other fibers with a number average single fiber diameter of 1 μm or more, and 3 wt% or less of the disarranged nanofibers.

(147) A nanofiber synthetic paper, according to said (132), wherein the disarranged nanofibers are laminated on a substrate.

(148) A nanofiber synthetic paper, according to said (147), wherein the substrate is selected from a woven fabric, knitted fabric, nonwoven fabric and foam.

(149) A compound synthetic paper comprising the nanofiber synthetic paper as set forth in said (132).

(150) A molded synthetic paper comprising the nanofiber synthetic paper as set forth in said (132).

(151) A filter comprising the nanofiber synthetic paper as set forth in said (132).

(152) A separator comprising the nanofiber synthetic paper as set forth in said (132).

(153) An abrasive comprising the nanofiber synthetic paper as set forth in said (132).

(154) A medical product comprising the nanofiber synthetic paper as set forth in said (132).

(155) A circuit board comprising the nanofiber synthetic paper as set forth in said (132).

(156) A method for producing a nanofiber synthetic paper by forming a paper sheet from a dispersion of beaten short nanofibers, characterized in that the paper sheet is formed without using a binder.

(157) A method for producing a nanofiber synthetic paper, characterized in that other fibers with a number average single fiber diameter of 1 μm or more are processed to form a paper sheet using disarranged nanofibers as a binder.

~~[Effects of the invention]~~

~~According to the present invention, in the recent fields of cosmetics, medical articles, etc., since nanofibers are mixed in a compound solution, emulsion or gel respectively, microparticles and nanoparticles such as precious metal particles, metal oxide particles or polymer particles of 1 μm or less can be homogeneously dispersed and the dispersion can be stabilized for a long period of time.~~

~~Furthermore, if a cosmetic product containing conventional fibers with a diameter of more than several micrometers is used, the user feels gritty. So, such fibers cannot be practically used in cosmetics. However, the nanofibers of this invention are thinner than the wrinkle creases of the skin surface and have good affinity with the skin, being able to give a soft and natural touch to the skin. The nanofibers contained in a cosmetic product can keep the cosmetic product good in slipperiness, water retention, moisture retention, smooth spreadability and packing property and can keep it lasting longer, being able to provide functions unavailable from the conventional fibers. Therefore, for using the features of nanofibers such as very small thickness and very large specific surface area, the nanofibers of this invention can be applied to numerous cosmetic items such as toilet waters, lotions, liquid foundations, shampoos, rinses, emulsions, cold creams, cleansing creams, shaving creams, hair creams, pack gels, ointment gels, hairdressing gels, face washing gels, soap gels and pack materials.~~

~~Furthermore, such effects as dispersibility, homogeneity and storage capability of nanofibers are effective not merely to cosmetics but also to the materials of medical field such as ointments, wet compresses, materials of cell culture and materials of albumin adsorption, the materials of electronic material and apparatus field such as materials of electrolytes for batteries, materials of catalyst carriers for fuel cells, materials of catalyst carriers for chemical filters and materials for adsorbing hazardous gases, the materials of architectural material field such as paints, adhesives and wall~~

~~coating materials respectively containing various fillers and pigments, the materials of industrial material field such as purifying filters and carriers of fine particles such as activated carbon and titanium oxide for purifying filters, coloring materials for pictures, etc.~~

~~Furthermore, in the fields where the conventional ordinary synthetic fibers and ultrafine fibers could not meet requirements, the compound solutions, emulsions and gels of this invention are expected to present surface activities and to allow chemical surface interactions at nanometer level, such as capabilities to adsorb or absorb various substances (such as fine particles, chemical substances, proteins, and pathogenic microbes), ecological adaptability and compatibility, etc.~~

~~On the other hand, more highly accurate products are required in the fields of filters (such as air filters, chemical filters and water purifying filters), mask filters, battery separators, blood filter materials of medical field, materials of extrasomatic circulation columns, materials of cell culture, insulating materials and electronic substrates as electronic materials, toilet paper, wiping paper, decorative paper for furniture, wall paper, paper for high quality printing, design paper, and high image quality printing paper. In these fields, the conventional ultrafine fibers and the nanofibers obtained by electrospinning are not sufficient in the uniformity of fiber diameter or cannot be accurately controlled in pore size or in the weight per unit area, thickness or density of the nonwoven fabric produced from the fibers. Moreover, according to the electrospinning method, a nonwoven fabric with a wide width cannot be efficiently produced due to such problems as the safety of working environment due to the evaporation of the solvent and the recovery of the solvent. If the nanofibers of this invention are used, highly accurate materials can be designed, and practical synthetic papers can be provided. Furthermore, this invention can meet the needs in the fields where the conventional synthetic fibers and ultrafine fibers could not meet such needs and where interactions of nanometer level such as the capability to adsorb or absorb various substances (fine~~

~~particles, chemical substances, proteins, etc.) and ecological adaptability and compatibility are needed. The synthetic papers of this invention can solve the conventional problems.~~

~~[~~Brief ~~d~~Description of the ~~d~~ Drawings~~]~~

~~[Fig. 1]~~Fig. 1 is a schematic drawing showing a spinning machine for "polymer alloy fibers" used as the raw fibers of nanofibers.

~~[Fig. 2]~~Fig. 2 is a transmission electron microscope (TEM) photograph showing forms of islands on a cross section of a polymer alloy fiber of Example 1.

~~[Fig. 3]~~Fig. 3 is an ultrahigh resolution scanning electron microscope (SEM) photograph showing the forms of nylon nanofibers on the surface of the synthetic paper of Example 29.

~~[Fig. 4]~~Fig. 4 is a photograph (Fig. 3) showing the surface of the synthetic paper of Example 29, image-processed for pore measurement.

~~[Fig. 5]~~Fig. 5 is a schematic drawing showing a device for removing the sea component from hanks.

~~[Fig. 6]~~Fig. 6 is a transmission electron microscope (TEM) photograph showing the forms of fibers on a cross section of the PPS nanofibers of Example 42.

~~[~~Meanings of ~~s~~Symbols~~]~~

1: hopper

2: melting portion

3: spin block

4: spinning pack

5: spinneret

6: chimney

7: filaments

8: filament-collecting finishing guide

9: first take-up roller

10: second take-up roller

11: winder

12: sea component-removing tank

13: ~~tratment~~treatment liquid plumbing

14: pump

15: upper bar

16: lower bar

17: treatment liquid hole

18: hank-like tow

19: sea component-removing liquid

~~[The best modes for carrying out the invention]~~Detailed Description

According to the present invention, in the recent fields of cosmetics, medical articles, etc., since nanofibers are mixed in a compound solution, emulsion or gel respectively, microparticles and nanoparticles such as precious metal particles, metal oxide particles or polymer particles of 1 μm or less can be homogeneously dispersed and the dispersion can be stabilized for a long period of time.

Furthermore, if a cosmetic product containing conventional fibers with a diameter of more than several micrometers is used, the user feels gritty. So, such fibers cannot be practically used in cosmetics. However, our nanofibers are thinner than the wrinkle creases of the skin surface and have good affinity with the skin, being able to give a soft and natural touch to the skin. The nanofibers contained in a cosmetic product can keep the cosmetic product good in slipperiness, water retention, moisture retention, smooth spreadability and packing property and can keep it lasting longer, being able to provide functions unavailable from the conventional fibers. Therefore, for using the features

of nanofibers such as very small thickness and very large specific surface area, the nanofibers of this invention can be applied to numerous cosmetic items such as toilet waters, lotions, liquid foundations, shampoos, rinses, emulsions, cold creams, cleansing creams, shaving creams, hair creams, pack gels, ointment gels, hairdressing gels, face washing gels, soap gels and pack materials.

Furthermore, such effects as dispersibility, homogeneity and storage capability of nanofibers are effective not merely to cosmetics but also to the materials of medical field such as ointments, wet compresses, materials of cell culture and materials of albumin adsorption, the materials of electronic material and apparatus field such as materials of electrolytes for batteries, materials of catalyst carriers for fuel cells, materials of catalyst carriers for chemical filters and materials for adsorbing hazardous gases, the materials of architectural material field such as paints, adhesives and wall coating materials respectively containing various fillers and pigments, the materials of industrial material field such as purifying filters and carriers of fine particles such as activated carbon and titanium oxide for purifying filters, coloring materials for pictures, etc.

Furthermore, in the fields where the conventional ordinary synthetic fibers and ultrafine fibers could not meet requirements, our compound solutions, emulsions and gels present surface activities and allow chemical surface interactions at nanometer level, such as capabilities to adsorb or absorb various substances (such as fine particles, chemical substances, proteins, and pathogenic microbes), ecological adaptability and compatibility, etc.

On the other hand, more highly accurate products are required in the fields of filters (such as air filters, chemical filters and water purifying filters), mask filters, battery separators, blood filter materials of medical field, materials of extrasomatic circulation columns, materials of cell culture, insulating materials and electronic substrates as electronic materials, toilet paper, wiping paper, decorative paper for furniture, wall paper, paper for high quality printing, design paper, and high

image quality printing paper. In these fields, the conventional ultrafine fibers and the nanofibers obtained by electrospinning are not sufficient in the uniformity of fiber diameter or cannot be accurately controlled in pore size or in the weight per unit area, thickness or density of the nonwoven fabric produced from the fibers. Moreover, according to the electrospinning method, a nonwoven fabric with a wide width cannot be efficiently produced due to such problems as the safety of working environment due to the evaporation of the solvent and the recovery of the solvent. If our nanofibers are used, highly accurate materials can be designed, and practical synthetic papers can be provided. Furthermore, we can meet the needs in the fields where the conventional synthetic fibers and ultrafine fibers could not meet such needs and where interactions of nanometer level such as the capability to adsorb or absorb various substances (fine particles, chemical substances, proteins, etc.) and ecological adaptability and compatibility are needed. The synthetic papers of this invention can solve the conventional problems.

Examples of the thermoplastic polymer constituting the disarranged fibers ~~of this invention~~ include polyesters, polyamides, polyolefins, polyphenylene sulfide (PPS), etc. The polyesters include polyethylene terephthalate (PET), polytrimethylene terephthalate (PTT), polybutylene terephthalate (PBT), polylactic acid (PLA), etc. Furthermore, the polyamides include nylon 6 (N6), nylon 66 (N66), nylon 11 (N11), etc. Moreover, the polyolefins include polyethylene (PE), polypropylene (PP), polystyrene (PS), etc. In addition to the aforesaid thermoplastic polymers, phenol resins, polyacrylonitrile (PAN), polyvinyl alcohol (PVA), polysulfones, fluorine-based polymers and their derivatives can of course be used.

Kindly replace paragraph [0037] with the following:

Especially polyamides typified by N6 and N66 are excellent in water absorbability and water retention, and if nanofibers of a polyamide are contained in the compound solution, emulsion or gel

~~of this invention~~ to use those properties, the obtained composition can be suitably used for cosmetic application, etc.

Kindly replace paragraph [0039] with the following:

The disarranged fibers ~~used in this invention~~ refer to nanofibers, the number average diameter of which as single fibers (number average single fiber diameter) is in a range from 1 to 500 nm. The disarranged fibers are in a mode in which single fibers are dispersed. Furthermore, the disarranged fibers are not limited in length or sectional form, if they are merely formed like fibers. In this invention, the average value and irregularity of the single fiber diameters of nanofibers are important. It is important that the nanofibers are homogeneously dispersed in the compound solution, emulsion, gel or synthetic paper, and especially it is important that the number average single fiber diameter in a compound solution, emulsion or gel is 1 to 500 nm, to improve the long-term stability lest the nanofibers should cohere to each other or settle with the lapse of time. A preferred range is 1 to 200 nm, and a more preferred range is 1 to 150 nm. A further more preferred range is 1 to 100 nm. Especially in the case where the synthetic paper ~~of this invention~~ is used as a filter, high performance and highly efficient collection are required as properties, and in the case where it is used as a separator or the like, high liquid impermeability is required as a property. So, it is desirable that the single fiber diameter of nanofibers is smaller, and in this case, it is preferred that the number average single fiber diameter is 1 to 150 nm. A more preferred range is 1 to 100 nm.

Kindly replace paragraphs [0048] through [0050] with the following:

$Pb = Q(\chi a) - Q(\chi b)$ (5)

~~In this invention, it~~It is preferred that the index Pb of extremal coefficient of the single fiber diameters expressing the rate of the fibers falling within a range of plus and minus 15 nm from the number average single fiber diameter defined as the median is 50% or more. More preferred is 60%

or more, and further more preferred is 70% or more. This means the irregularity of single fiber diameters, i.e., the degree to which single fibers with diameters close to the number average single fiber diameter are concentrated. A higher Pb values means that the irregularity of single fiber diameters is smaller. The actual methods for measuring the number average single fiber diameter ϕm, the sum Pa of single fiber ratios and the index Pb of extremal coefficient of single fiber diameters are explained in the examples described later.

~~In this invention, said~~The disarranged nanofibers can be used to make the intended compound solution, emulsion and gel. This can be achieved only when the aforesaid nanofibers are used. For example, since the nanofibers obtained by the electrospinning can be usually collected only in the form of a nonwoven fabric, there is no idea of homogeneously dispersing the obtained nanofibers into a solvent, and it is difficult to do so. Actually there has been no case of dispersing the nanofibers into a solvent. On the other hand, in this invention, a melt spinning method with high productivity is used to obtain polymer alloy fibers, and the sea component is removed from them to obtain an aggregate of nanofibers. They are further shortened, beaten and dispersed to obtain disarranged nanofibers. Therefore, the compound solution, emulsion and gel as described above could be efficiently produced for the first time.

The nanofiber compound solution, emulsion or gel ~~of this invention consists of~~includes disarranged nanofibers and a solvent or gel. The compound solution, emulsion or gel of this invention refers to a liquid or solid in which nanofibers, or nanofibers and another chemical substance are mixed in a solvent or gel.

In the compound solution~~ of this invention~~, the disarranged nanofibers are dispersed in a solvent at a relatively low concentration. So, the compound solution has a relatively low viscosity and is highly flowable. Meanwhile, a substance having the disarranged nanofibers in a solvent or gel

at a relatively high concentration, to have a relatively high viscosity and low flowability, is defined as a gel. Furthermore, a compound solution formed as an emulsion, having disarranged nanofibers dispersed in the emulsion at a relatively low concentration, is defined as an emulsion.

Kindly replace paragraph [0053] with the following:

The nanofibers with a single fiber diameter of 1 to 500 nm ~~used in this invention~~ are compared with the conventional synthetic fibers hereunder. For the two types of conventional fibers, i.e., fibers with a diameter of 10 μm or more (hereinafter called the ordinary fibers) and fibers with a diameter of more than 0.5 μm to 10 μm (hereinafter called the ultrafine fibers), and for the fibers used in this invention with a diameter of 0.5 μm (500 nm) or less (nanofibers A and B), Table 1 shows typical fiber diameters of the respective types of fibers.

Kindly replace paragraph [0061] with the following:

In this regard, if the nanofiber compound solution, emulsion or gel ~~of this invention~~ is used, the above problem can be solved. The nanofiber compound solution ~~of this invention~~ contains 18 million nanofibers per 1 ml of the solution as shown in Table 1, and the specific surface area is also very large. Furthermore, if the nanofibers are cut fibers with a fiber length of 2 mm, the ratio of fiber length (L)/fiber diameter (D), i.e., aspect ratio is 10000 to 33000 as shown in Table 1. These fibers are very long. So, if these nanofibers are added into a compound solution, emulsion or gel, the above-mentioned fine particles of micron level, nanoparticles or the like can be uniformly carried on the surfaces of the nanofibers. In this way, fine particles of a precious metal with a large specific gravity or fine particles of various compounding ingredients such as UV-shielding reagent can be dispersed scatteringly without causing cohesion or can be prevented from cohering to each other. Furthermore, if the narrow and long nanofibers act on the fine particles lightly cohering to each other

to form flocks or clusters in the solution, the particles are stirred or rubbed to destroy the flocks or clusters, for allowing homogenous dispersion.

Kindly replace paragraphs [0066] through [0067] with the following:

Moreover, as the nanofibers ~~of this invention~~, it is preferred that the ratio (L/D) of the fiber length L (mm) to the number average diameter D (mm) is 100 to 50000. If L/D is kept in this range, the dispersibility of nanofibers in the compound solution, emulsion or gel ~~of this invention~~ can be enhanced. Furthermore, in the synthetic paper of this invention, if L/D is kept in the aforesaid range, a sheet having single nanofibers homogeneously dispersed in the synthetic paper can be obtained, and in addition, since the nanofibers can be more entangled with and adhesive to each other, the paper force of the synthetic paper can be enhanced. In the case of compound solution, emulsion or gel, a more preferred range is 1000 to 20000, and a further more preferred range is 500 to 2000. In the case of synthetic paper, it is more preferred that L/D is 1000 to 35000, and a further more preferred range is 3000 to 20000.

~~In this invention, the~~The compound solution especially containing the nanofibers is good in transparency. The transparency is evaluated according to the measuring method of "P. Transparency" described for the examples given later. For example as in Example 6, the rate of light transparency of a nanofiber compound solution containing 0.01 wt% of nanofibers with a fiber length of 2 mm is 51%. So, the solution has excellent transparency. In this case, though the fiber diameter of the nanofibers is 60 nm, being smaller than the wavelength of light (400 to 700 nm), the fiber length is as very large as 2 mm (2000000 nm). Furthermore, as shown in Table 1, even though the number of nanofibers existing per 1 ml of the solution is as very large as 18 million, the transparency is very good. This is considered to be attributable to the effect of nanofibers homogeneously dispersed as single fibers. To further enhance the transparency, it is preferred that the fiber

concentration of the solution is 0.0001 to 0.01 wt%, and that the fiber length is as short as 0.05 to 0.8 mm. A more preferred range is 0.05 to 0.2 mm. If the nanofiber concentration is too low or if the fiber length is too short, the effect of stabilization by the dispersion of nanofibers declines. Moreover, for improving the rate of light transparency, it is also effective to use an adequate dispersing agent. When 0.1 wt% of an anionic dispersing agent was added to a N6 nanofiber compound solution, the rate of light transparency rose to 63% (Example 9 given later). Furthermore, since the nanofibers have a fiber diameter smaller than the wavelength of light, it is theoretically transparent in the diameter direction, but since the fiber length is very long compared with the wavelength of light, transparency is considerably impaired by the influence of overlapping fibers, suspected adhesion, clusters, flocks, etc., and irregular reflection is also likely to occur. To prevent irregular reflection and to improve transparency, it is also preferred to coat or wet the surfaces of nanofibers with a silicone-based polymer, fluorine-based polymer, urethane-based polymer, acrylic polymer or the like for adjusting the refractive index.

Kindly replace paragraphs [0076] through [0077] with the following:

The compound solution, emulsion and gel having the nanofibers ~~of this invention~~ dispersed in them have been explained mainly in reference to their use as cosmetics. However, the dispersibility, homogeneity and storage stability of the nanofibers can be used not merely for cosmetics but also for the materials of medical field such as ointments, wet compresses, materials of cell culture and materials of albumin adsorption, the materials of electronic material and apparatus field such as materials of electrolytes for batteries and their carriers, materials of catalyst carriers for fuel cells, materials of catalyst carriers for chemical filters and materials of hazardous gas adsorption, the materials of architectural material field such as paints, adhesives and wall coating materials respectively containing various fillers and pigments, the materials of industrial material field such as

purifying filters and carriers of fine particles such as activated carbon and titanium oxide for purifying filters, coloring materials for pictures, etc.

The method for producing the nanofibers to be used in the compound solution, emulsion, gel and synthetic paper ~~of this invention~~ will be described below.

Kindly replace paragraph [0091] with the following:

It is preferred that the nanofibers ~~used in this invention~~ are short fibers, to improve the homogeneous dispersibility and long-term storage stability of nanofibers, and it is preferred to remove the sea component from the "polymer alloy fibers" and then to cut them into short fibers. Furthermore, it is preferred to beat the cut fibers.

Kindly replace paragraph [0128] with the following:

Furthermore, the "gel" produced herein ~~this invention~~ refers to a gel obtained by adding a solvent or gel to nanofibers and further, as required, adding a certain material. The certain material refers to a polymer gel such as PVA gel or acrylamide gel or a natural material gel such as a polysaccharide. Furthermore, since the aforesaid "structural gel" of nanofibers is a pseudo gel, though it does not have a crosslinked structure, it is also included in the "gel." ~~of this invention.~~ The gel with a high nanofiber concentration can be produced with the nanofiber concentration kept at 10 to 30 wt% when the nanofibers are beaten. Furthermore, to obtain a highly concentrated nanofiber gel, a dispersing agent such as an acrylamide-based dispersing agent, silicon-based dispersing agent or fluorine-based dispersing agent can be added to enhance the homogeneity of dispersion. The method for selecting an adequate dispersing agent is as described before, and an anionic, cationic or nonionic dispersing agent can also be suitably used. Moreover, it is preferred that the dispersing agent concentration is 0.00001 to 20 wt% based on the total weight of the gel. A more preferred

range is 0.0001 to 5 wt%, and a further more preferred range is 0.01 to 1 wt%. If the dispersing agent concentration is in this range, a sufficient dispersion effect can be obtained.

Kindly replace paragraph [0133] with the following:

Furthermore, the synthetic paper ~~of this invention~~ has a feature that the specific surface area is dramatically large, since the number average single fiber diameter of the disarranged nanofibers used in the synthetic paper of this invention is 1/10 to 1/100 of those of the conventional ultrafine fibers. Therefore, the synthetic paper shows peculiar properties not observed in the synthetic paper composed of usual ultrafine fibers, and it is expected that the adsorption properties can be greatly improved. That is, the synthetic paper is likely to adsorb water vapor (hygroscopic), chemical reagent vapors (odors), fine powders, dusts, etc.

Kindly replace paragraphs [0135] through [0136] with the following:

Furthermore, if nanofibers with a very small fiber diameter compared with the conventional ultrafine fibers are used, even a synthetic paper with a very small weight per unit area of 2 g/m^2 as shown in Example 33 given later has few pinholes and uniform evenness. Thus, a synthetic paper having a very small thickness and yet a very low air permeability can be produced. This synthetic paper can be used, for example, as a battery separator material allowing the migration of ions, trace gas or trace chemical substance but not allowing the mass migration of a liquid. Meanwhile, in medical surgery, the leak of body fluid or ascites fluid from the diseased part during or after surgery can be a fatal impairment or the leaking body fluid or ascites fluid can cause contamination with another pathogenic microbe. So, a diaphragm for operation compatible with the organism and capable of preventing the leak of body fluid is needed. As the material, an antithrombotic polymer film has been used, but the polymer film is not flexible being a material difficult to handle during

surgery. The synthetic paper ~~of this invention~~ is suitable also for use as such a diaphragm for operation.

Furthermore, the synthetic paper ~~of this invention~~ has a feature that the nanofibers are dispersed into individual single fibers, and a synthetic paper uniform in the weight per unit area, thickness, evenness, etc. can be obtained as described in Example 29 given later. Moreover, the nanofiber synthetic paper does not contain the powdery fiber refuse produced by damaged nanofibers when the nanofibers are beaten, and when a synthetic paper is produced from the nanofibers, a uniform sheet with few defects can be formed.

Kindly replace paragraph [0141] with the following:

The thickness of the synthetic paper ~~of this invention~~ is not especially limited, since it can be freely controlled to suit each object by adjusting the weight per unit area. However, to obtain good papermaking properties and a synthetic paper with good evenness, and to sufficiently withstand stresses such as the tensile stress acting when the synthetic paper is processed into various products such as a filter and a separator, it is preferred that the thickness is 10 μm or more. More preferred is 100 μm or more, and further more preferred is 150 μm or more. It is preferred that the upper limit of thickness is 5000 μm (5 mm) or less.

Kindly replace paragraphs [0143] through [0148] with the following:

The synthetic paper ~~of this invention~~ can be produced even without a binder, aggregate or base material, etc., even if it is a thin synthetic paper with a weight per unit area of 8 g/m^2 as described in Example 29 given later. The reason is considered to be that since the nanofibers have a high force to cohere with each other, though difficult to disperse, the high cohesive force can be very conveniently used on the contrary for papermaking, and that the nanofibers can be excellently entangled with and adhere to each other.

Furthermore, in order to obtain such nanofibers with good papermaking properties, it is preferred that the freeness of the nanofibers is 350 or less. More preferred is 200 or less, and further more preferred is 100 or less. It is preferred that the lower limit of freeness is 5 or more. Moreover, if such nanofibers are used, a synthetic paper can be produced even if the weight per unit area is as very low as 2 g/m^2 as described in Example 33 given later. The nanofiber synthetic paper of Example 33 given later is based on a screen woven fabric, but the nanofibers existing in the meshes of the screen woven fabric, i.e., in the meshes of lattice do not form large pinholes even though there is no binder, and the sheet is uniformly even.

Furthermore, since the single fiber diameters of the disarranged nanofibers in the synthetic paper ~~of this invention~~ are uniform, the pores formed among the nanofibers of the synthetic paper are also uniform in size. The formation of the pores is governed by the polymer used as the nanofibers and the rigidity of nanofibers depending on the single fiber diameter. That is, since the nanofibers are bent, the pores are formed by the positions of the nanofibers existing in the synthetic paper, the diameters of the nanofibers and the entanglement among the nanofibers. The average pore diameter is several to about 10 times the single fiber diameters of the nanofibers. For example, to efficiently collect the fine particles or a component desired to be removed from a fluid such as a gas or liquid, it is preferred that the pore area of the nanofiber synthetic paper is 1.0 μm^2 (pore diameter 1.1 μm) or less. More preferred is 0.5 μm^2 (average pore diameter 0.75 μm) or less. It is preferred that the lower limit of pore area is 10 nm^2 or more, and more preferred is 50 nm^2 or more.

Moreover, in the nanofiber synthetic paper ~~of this invention~~, the pore diameters are on the nanometer level, but it is also another feature of the synthetic paper that the irregularity of pore diameters is small. Since the irregularity of pore diameters is small, various fine particles (generally refer to dusts, foreign matters, various proteins, bacteria, etc.) can be classified. Even if a synthetic

paper of nanofibers is used to merely produce a filter with pore diameters of nanometer size, clogging may occur soon. So, it may be necessary to employ, for example, an adsorption method in which a gas or liquid is made to flow in parallel to the surface of the synthetic paper. Anyway, the uniformly very fine pores of the nanofiber synthetic paper are expected to exhibit any function using the collection performance on the nanometer level.

It is preferred that the nanofiber synthetic paper ~~of this invention~~ has an air permeability of 30 cc/cm^2/sec or less. If the synthetic fiber has a low air permeability, i.e., a high gas impermeability, it can be used, for example, as a partition wall such as a separator. A more preferred air permeability is 15 cc/cm^2/sec or less, and further more preferred is 5 cc/cm^2/sec or less. The most preferred is 1 cc/cm^2/sec or less. It is preferred that the lower limit of air permeability is 0.25 cc/cm^2/sec or more.

The synthetic paper ~~of this invention~~ also has a feature that since the voids in the synthetic paper are densely packed with the disarranged nanofibers, the pinholes through the synthetic paper are inhibited. More particularly, it is preferred that the number of pinholes with an equivalent diameter of 50 μm or more penetrating from the front surface to the back surface of the paper is 0 to 1000 holes/cm^2. If the number of pinholes is kept at 1000 holes/cm^2 or less, the air permeability, liquid permeability, etc. can be kept low. A more preferred number of pinholes is 100 holes/cm^2 or less, and a further more preferred number is 15 holes/cm^2 or less. The most preferred number is 3 holes/cm^2 or less.

It is preferred that the synthetic paper ~~of this invention~~ has a surface smoothness of 300 seconds or more. The surface smoothness in this case refers to the surface smoothness (in seconds) measured by the Bekk method specified in JIS P 8119-1976. If the surface smoothness is high, the nanofiber synthetic paper ~~of this invention~~ can be used in an application requiring smoothness such as a circuit board using insulating paper. A more preferred surface smoothness is 1000 seconds or

more, and a further more preferred smoothness is 1500 seconds or more. A still further more preferred smoothness is 3000 seconds or more. It is preferred that the upper limit of the surface smoothness is 20000 seconds or less.

~~In this invention, a~~A mixed fiber synthetic paper consisting of disarranged nanofibers with a number average single fiber diameter of 500 nm or less and at least 5 wt% or more of other fibers with a number average single fiber diameter of 1 μm or more can also be produced. It is preferred that the disarranged nanofibers have a number average single fiber diameter of 200 nm or less. The mixing weight rate of nanofibers can be measured according to "T. Method for measuring the mixing weight rate of nanofibers" described for the examples given later. If disarranged nanofibers and other fibers with a single fiber diameter of 1 μm or more are mixed to form a paper sheet, the nanofiber synthetic paper obtained can be made bulky.

Kindly replace paragraphs [0151] through [0154] with the following:

~~In this invention, a~~A nanofiber synthetic paper in which disarranged nanofibers with a number average single fiber diameter of 500 nm or less, preferably 200 nm or less are laminated on a substrate can also be produced. If disarranged nanofibers are laminated on a substrate, the reinforcing effect by the substrate can improve the strength of the synthetic paper of this invention. In addition, if a small amount of disarranged nanofibers are laminated on a substrate, the efficiency of collecting various substances by nanofibers can be enhanced while the gas or liquid permeability can be controlled. So, such a synthetic paper can be used as a filter, etc. As for the lamination method, a papermaking technique can be used, or the substrate can be impregnated with a dispersion of nanofibers, or the dispersion can be added dropwise to the substrate, or the substrate can be sprayed or coated with the dispersion. Other methods can also be used. As the substrate, a woven

fabric, knitted fabric, nonwoven fabric, foam or the like can be adequately selected for each application or purpose.

~~In this invention, a~~A compound synthetic paper containing the aforesaid nanofiber synthetic paper or a molded synthetic paper can also be produced. Furthermore, the nanofiber synthetic paper can be used to produce a filter, separator, abrasive, medical product or circuit board.

~~In this invention, as~~As described in the text and examples, a nanofiber synthetic paper can be produced without using a binder. A natural pulp can be processed into paper without using a binder, since the fibers are branched. Various methods have been studied to make paper by fibrillating, for example, a thermoplastic polymer, but it has been very difficult to make paper without using a binder. Furthermore, it has been difficult to make paper even from the conventional ultrafine fibers with a very small number average single fiber diameter of 0.5 μm or more without using a binder.

As described before, since the disarranged nanofibers ~~of this invention~~ can cohere with and be entangled with each other, paper can be made from them like a natural pulp, and a synthetic paper can be produced from them without using a binder. Furthermore, as described in Example 32 given later, disarrange nanofibers can be used as a binder to make paper from ordinary synthetic fibers or ultrafine fibers, and disarranged nanofibers can also be used as a binder to make a synthetic paper from synthetic thermoplastic polymer fibers with a number average single fiber diameter of 1 μm or more.

Kindly replace paragraphs [0161] through [0162] with the following:

Particular examples and processed product examples of compound solutions, emulsions, gels and synthetic papers using the nanofibers of this invention are described below~~, but this invention~~. However, this disclosure is not limited thereto or thereby.

~~[~~Examples~~]~~

~~This~~Selected representative aspects of this invention will be described below in detail in reference to examples. In the examples, the following measuring methods were used. The measured results of examples and comparative examples are collectively shown in Tables 3 to 9.

Kindly replace paragraphs [0170] through [0171] with the following:

J. Evaluation of the sum Pa of single fiber ratios of nanofibers

For the sum Pa of single fiber ratios, the data measured in the above item I was used, and the sum was obtained from the formula (3~~) stated in "The best modes for carrying out the invention"~~. A larger Pa value means smaller irregularity.

K. Evaluation of the index Pb of extremal coefficient of single fiber diameters of nanofibers

For the index Pb of extremal coefficient of single fiber diameters, the data measured in the above item I was used, and the index was calculated from the formula (5~~) stated in "The best modes for carrying out the invention"~~. The index indicates the degree to which single fibers with diameters close to the number average single fiber diameter are concentrated, and a higher index Pb value means smaller irregularity.

Kindly delete paragraph [0294].

Kindly replace paragraphs [0303] through [0304] with the following:

~~[~~Industrial ~~applicability]~~Applicability

The compound solutions, emulsions and gels ~~of this invention~~ can be used as toilet articles such as beauty care liquids, packs an foundations, medical products such as ointments, wet compresses, materials of cell culture and materials of albumin adsorption, materials of electrolytes and materials of catalyst carriers for various batteries, materials of catalyst carriers for chemical filters, materials for adsorbing hazardous gases, products for architectural materials such as paints,

adhesives and wall coating materials, carriers of particles such as activated carbon and titanium oxide for filters, coloring materials for pictures, etc. Furthermore, the compound solutions, emulsions and gels can be used as raw materials for producing various fibrous structures by means of spraying, coating, dipping, etc.

Moreover, the synthetic papers ~~of this invention~~ can be used as battery separators, abrasives, industrial filters such as air filters and liquid filters, medical products such as blood filters, insulating paper, circuit boards, etc.

After paragraph [0304], kindly insert Tables 1 through 9 as follows:

Table1. Comparison of diameter and numbers per 1cc in 0.01% solution by kind of fiber

Kind of fibers	Fiber diameter (μm)	Number of fibers (0.01by weight、per 1ml)	Specific surface (m^2/g)	Aspect ratio (2mm length)
Ordinary fibers	20	160	0.035	100
Ultrafine fibers	2	16,000	0.35	1000
Nanofibers A	0.2	1.6 million	3.5	10000
Nanofibers B	0.06	18 million	10.5	33000

Table2. Comparison of diameter by kind of fiber, and rigidity values

Kind of fibers	Fiber diameter (μm)	Rigidity values (Relatively compared)
Ordinary fibers	20	1
Ultrafine fibers	2	1×10^{-4}
Nanofibers A	0.2	1×10^{-8}
Nanofibers B	0.06	8.1×10^{-11}

Table3. Distribution of fiber diameter in Example 1

No	Diameter : ϕ	Frequency : f	Product : ϕ*f
1	0	0	0
2	10	2	20
3	20	5	100
4	30	13	390
5	40	32	1280
6	50	54	2700
7	60	81	4860
8	70	65	4550
9	80	36	2880
10	90	11	990
11	100	1	100
Number N		300	17870
Number average single fiber diameter ϕm			60
Sum Pa of simple fiber ratios			100%
Index Pb of extremal coefficient of single fiber diameter			66%

Table 4.

	Kind of fibers	Length of fibers	Freenes		concentration of NanoF	State of compound	ϕm	Pa	Pb	Settling time	Transparency	Dispersing agent	
		mm	1st step beaten	2nd step beaten	wt%		nm	%	%	Min.	%	Kind	concentration (wt%)
Example 1	NanoF of Nylon6	2	362	64	10	Gel	60	100	66	—	—	—	—
Example 2	NanoF of Nylon6	2	—	157	0.10	Compound solution(water)	63	100	61	—	1.8	—	—
Example 3	NanoF of Nylon6	2	—	157	0.01	Compound solution(water)	63	100	61	12	53	—	—
Example 4	NanoF of Nylon6	2	362	64	1.0	Compound solution(water)	60	100	66	—	0	—	—
Example 5	NanoF of Nylon6	2	362	64	0.10	Compound solution(water)	60	100	66	—	1.2	—	—
Example 6	NanoF of Nylon6	2	362	64	0.01	Compound solution(water)	60	100	66	10	51	—	—
Example 7	NanoF of Nylon6	2	362	64	1.0	Compound solution(water)	60	100	66	—	0	Anion	0.10
Example 8	NanoF of Nylon6	2	362	64	0.10	Compound solution(water)	60	100	66	360	2.4	Anion	0.10
Example 9	NanoF of Nylon6	2	362	64	0.01	Compound solution(water)	60	100	66	—	63	Anion	0.10
Example 18	NanoF of Nylon6	2	—	—	0.10	Compound solution(ethanol)	61	100	64	—	—	—	—
Example 19	NanoF of Nylon6	2	—	—	0.10	Compound solution(toluene)	62	100	63	—	—	—	—
Example 22	NanoF of Nylon6	0.2	152	32	0.01	Compound solution(water)	58	100	67	740	78	Anion	0.10
Example 23	NanoF of Nylon6	0.5	—	43	0.01	Compound solution(water)	58	100	67	520	70	Anion	0.10
Example 24	NanoF of Nylon6	1	—	58	0.01	Compound solution(water)	58	100	67	410	68	Anion	0.10
Example 25	NanoF of Nylon6	0.2	—	32	0.01	Compound solution(water)	58	100	67	452	65	Anion	10
Example 26	NanoF of Nylon6	0.2	—	32	0.01	Compound solution(water)	58	100	67	627	83	Anion	0.01
Example 27	NanoF of PBT	0.5	—	98	0.01	Compound solution(water)	52	100	69	669	81	Nonion	0.10
Example 28	NanoF of PP	0.8	—	104	0.01	Compound solution(water)	154	100	69	597	72	Nonion	0.01

NanoF : nanofibers

Table5.

	Kind of fibers	Length of fibers	Freenes		concentration of NanoF	State of compound	ϕm	Pa	Pb	Settling time	Transparency	Dispersing agent	
		mm	1st step beaten	2nd step beaten	wt%		μm	%	%	Min.	%	Kind	concentration (wt%)
Comparative Example 1	Nylon6(27 μm)	2	—	—	0.10	Compound solution(water)	27	0	92	—	66	—	—
Comparative Example 2	Nylon6(27 μm)	2	—	—	0.01	Compound solution(water)	27	0	92	2.7	87	—	—
Comparative Example 3	Nylon6(2 μm)	2	—	—	0.10	Compound solution(water)	2.1	0	88	—	14	—	—
Comparative Example 4	Nylon6(2 μm)	2	—	—	0.01	Compound solution(water)	2.1	0	88	1.1	52	—	—
Comparative Example 5	Nylon6(27 μm)	2	—	—	0.01	Compound solution(water)	27	0	88	3.7	—	Anion	0.10
Comparative Example 6	Nylon6(2 μm)	2	—	—	0.01	Compound solution(water)	2.1	0	88	1.3	—	Anion	0.10

Table6.

	Structure of synthetic paper	Binder	Base material	ϕm	Pa	Pb	Papermaking property	Weight per unit area	Thickness	Density	Average pore area	Air permeability	Surface smoothness	Strength	Elongation	Moisture absorption coeiffcient
				nm	%	%		g/m^2	μm	g/cm^3	μm^2	cc/cm^2/sec	sec.	N/cm	%	%
Example 29	NanoF : 100%	None	None	57	100	64	○	8.4	30	0.28	0.0033	0.35	1660	2.2	12	6.4
Example 30	Whole synthetic paper	None		—	—	—	○	45.6	102	0.45	—	0.27	830	91.2	34	5.7
	Screen woven fabric		Screen woven fabric	—	—	—	—	37.4	70	0.53	—	—		—	—	—
	NanoF : 100%			58	100	66	—	8.2	32	0.26	0.0045	—		—	—	—
Example 31	Whole synthetic paper	None	None				○	32.3	154	0.21	0.0113	11	320	1.5	7.3	5.1
	NanoF : 80%			59	100	65	—	—	—	—	—	—		—	—	—
	Ultrafine fibers : 20%						—	—	—	—	—	—		—	—	—
Example 32	Whole synthetic paper	Pulp	None				○	31.6	243	0.13	0.0470	34	220	3.1	15	—
	NanoF : 2.4%			59	100	63	—	—	—	—	—	—		—	—	—
	Ultrafine fibers : 87%						—	—	—	—	—	—		—	—	—
Example 33	Whole synthetic paper	None	None				○	39.5	78	0.51	—	0.66	430	91.2	34	—
	NanoF : 100%		Screen woven fabric					37.4	70	0.53	—	—		—	—	—
				57	99	73		2.1	8.0	0.26	0.0042	—		—	—	—
Example 34	Whole synthetic paper	None	None				○	46.9	111	0.42		0.63	1180	91.2	34	—
	NanoF : 100%		Screen woven fabric					37.4	70	0.53	—	—		—	—	—
				114	98	58		8.7	41	0.21	0.0084	—		—	—	—
Example 35	NanoF : 100%	—	Ultrafine fibers Pulp paper	57	99	72	○	42.2	285	0.15	0.0174	23	560	3.2	16	—
Example 36	NanoF : 100%	—	Nonwoven fabric	57	99	63	○	35.6	160	0.23	0.0153	15	380	3.5	43	—
Example 37	Whole synthetic paper	None	None				○	46.5	108	0.44	—	0.33	900	91.2	34	—
	NanoF : 100%		Screen woven fabric					37.4	70	0.53	—	—		—	—	—
				59	98	71		9.1	38	0.24	0.0051	—		—	—	—
Example 38	NanoF : 100%	None	None	56	100	62	○	8.4	34	0.26	0.0037	0.37	1680	2.0	13	6.1

NanoF : nanofibers

Table7.

	Structure of synthetic paper	Binder	Base material	φm	Pa	Pb	Papermaking property	Weight per unit area	Thickness	Density	Average pore area	Air permeability	Surface smoothness	Strength	Elongation	Moisture absorption coeiffcient
				nm	%	%		g/m^2	μm	g/cm^3	μm^2	cc/cm^2/sec	sec.	N/cm	%	%
Example 39	Whole synthetic paper	None		—	—	—	○	45.8	100	0.46	—	0.40	970	90.4	32	—
	Screen woven fabric		Screen woven fabric	—	—	—	—	37.4	70	0.53	—	—		—	—	—
	NanoF : 100%			102	100	69	—	8.4	30	0.28	0.0040	—		—	—	—
Example 40	Whole synthetic paper	None		—	—	—	○	45.7	102	0.45	—	0.73	770	91.2	33	—
	Screen woven fabric		Screen woven fabric	—	—	—	—	37.4	70	0.53	—	—		—	—	—
	NanoF : 100%			154	100	69	—	8.3	32	0.26	0.0062	—		—	—	—
Example 41	Whole synthetic paper	None		—	—	—	○	45.6	101	0.45	—	0.29	1710	91.4	32	—
	Screen woven fabric		Screen woven fabric	—	—	—	—	37.4	70	0.53	—	—		—	—	—
	NanoF : 100%			60	100	63	—	8.2	31	0.26	0.0044	—		—	—	—
Example 42	Whole synthetic paper	None		—	—	—	○	—	—	—	—	—	650	—	—	—
	Nonwoven fabric		Nonwoven fabric	—	—	—	—	—	—	—	—	—		—	—	—
	NanoF : 100%			57	100	64	—	—	30	—	—	—		—	—	—
Example 43	Whole synthetic paper	None		—	—	—	○	—	—	—	—	—	—	—	—	—
	Foam		Foam	—	—	—	—	—	—	—	—	—		—	—	—
	NanoF : 100%			57	100	64	—	—	30	—	—	—		—	—	—
Example 44	Whole synthetic paper	None		—	—	—	○	38.2	71	0.54	—	28	390	—	—	—
	Screen woven fabric		Screen woven fabric	—	—	—	—	37.4	70	0.53	—	—		—	—	—
	NanoF : 100%			58	100	66	—	0.8	3.2	0.25	0.0043	—		—	—	—
Comparative Example 9,10,11	2μmPET 2、3、5mm length	None	None	—	—	—	×	—	—	—	—	—	—	—	—	—
Comparative Example 12,13,14	2μmPET	None	None,Filter paper, Screen woven fabric	—	—	—	×	—	—	—	—	—	—	—	—	—
Comparative Example 15,16,17	2μmPET content 4、6、8g	None	None	—	—	—	×	—	—	—	—	—	—	—	—	—
Comparative Example18	1μmPET	None	None	883	0	8	△	28.3	122	0.23	1.5	—	—	—	—	2.8

NanoF : nanofibers

Table8. Distribution of fiber diameter in Example 29

No	Diameter : ϕ	Frequency : f	Product : ϕ*f
1	0	0	0
2	10	2	20
3	20	6	120
4	30	18	540
5	40	44	1760
6	50	63	3150
7	60	76	4560
8	70	56	3920
9	80	25	2000
10	90	9	810
11	100	1	100
Number N		300	16980
Number average single fiber diameter ϕm			57
Sum Pa of single			100%
Index Pb of extremal coefficient of single fiber diameter			64%

Table9. Distribution of fiber diameter in Comparative Example 18

No	Diameter : ϕ	Frequency : f	Product : ϕ*f
0	550	0	0
1	600	5	3000
2	650	10	6500
3	700	17	11900
4	750	26	19500
5	800	41	32800
6	850	50	42500
7	900	55	49500
8	950	36	34200
9	1000	24	24000
10	1050	14	14700
11	1100	9	9900
12	1150	3	3450
13	1200	2	2400
14	1250	3	3750
15	1300	1	1300
16	1350	2	2700
17	1400	2	2800
	Number N	300	264900
Number average single fiber diameter ϕm			883
Sum Pa of simple fiber ratios			0%
Index Pb of extremal coefficient of single fiber diameter			8%